

ENERGY

INDUSTRY

INSIDER

# Q4 2019 | Pulse Grid Scale Energy Storage

FutureBridge

# WHAT'S INSIDE!

- The trend of grid scale energy storage projects deployment continues in this quarter
- The quarter witnessed multiple mergers and acquisitions
- Market witnessed projects based on Cryogenic Energy Storage Technology and Advanced Compressed Air Energy Storage Technology

## 01

### **Pulse themes:**

- a. New Energy Storage projects are being installed across the US and Europe
- b. Mergers and Acquisitions taking place in energy storage market
- c. New Technologies are securing place in the market

## 02

### **New Technologies deployed in projects**

- a. Cryogenic Energy Storage
- b. Advanced Compressed Air Energy Storage

## 03

### **Startup Tracker highlights**

- a. Summary, investment & funding
- b. Geographical Outlook

# 01

## Emerging trends



The grid-scale energy storage projects deployed in the quarter aim to serve one or more of these benefits- Replacement of fossil fuel plants, peak power reduction, consumer electricity cost reduction, frequency regulation, voltage control, inertia benefits and increased renewable energy integration into the grid.

## New Energy Storage Projects are Being Installed across the US and Europe



### **New York Approves 316MW Battery Peak Power Plant**

- Under 'Green New Deal' launched in January 2019, New York's utility regulator has approved construction of a 316 MW battery storage plant under Ravenswood project, to replace fossil-fuel capacity and providing emissions-free power to the New York City region during the hours of greatest demand.



### **Ørsted commences construction on the company's first utility-scale solar plus battery storage project**

- Ørsted announced the ground breaking of the company's first utility-scale solar plus battery storage project located in United States.
- The 460 MW Permian Energy Center will make Ørsted the first energy company to operate the full spectrum of on- and offshore wind, solar PV and storage solutions in the US market.



### **Sungrow to supply energy storage system to solar-plus-storage project in Massachusetts**

- Sungrow has entered into a contract to supply its fully integrated energy storage system (ESS) ST4200KWh-2000 to a 15-MW/32-MWh solar-plus-storage project in Massachusetts.
- This is the first solar-plus-storage under Solar Massachusetts Renewable Target (SMART) Program that will participate in ISO-New England wholesale markets after completion.



### **Enel X has completed the largest battery storage project in New York City under a peculiar business model**

- Enel X partnered with Related Companies to launch a 4.8 MW/16.4 MWh battery storage project located in Brooklyn using peculiar business model.
- It will support the local grid to serve peak demand and improving network reliability.

#### DEVELOPMENTS

#### Emerging Trends



Following the past quarter, multiple grid-scale energy storage projects were planned, approved, completed or commissioned in this quarter. Though the developments were seen across the globe, the US and Europe seem to be leading

the grid-scale energy storage market. The quarter witnessed multiple remarkable projects across the US and Europe.

**FutureBridge Insight & What should you investigate ?**



## New Energy Storage Projects are Being Installed across the US and Europe



### Ireland to implement 110 MW capacity of storage projects

- Irish grid authority Eirgrid Group finalized three large scale storage projects in the recently held auction under the DS3 program.
- The selected projects have a combined capacity of 110 MW and aims to enable the Irish electricity grid to raise the contribution of renewables from 50% to 65%.



### Spain's first distribution grid-connected battery storage plant to be powered by Iberdrola

- i-DE, the electricity distribution arm of Iberdrola, has powered a 3MWh battery energy storage system in Spain.
- This battery energy storage system is claimed to be the first ever distribution grid-connected lithium-ion battery project in Spain.



### Fotowatio Renewable Ventures announces its first battery project as its plans to develop energy storage projects globally

- Part of Abdul Latif Jameel Energy, Fotowatio Renewable Ventures (FRV), has laid out a strategic long-term investments plan for development of battery energy storage projects at global scale, and announced its first battery project to be built in UK. FRV's first battery energy storage project, Holes Bay, will be a first-of-a-kind development in the UK and Europe, utilizing cutting-edge control and storage technologies.



### Sungrow connects 27.5MW/30MWh solar-plus-storage project to the UK grid

- Sungrow has announced that Yorkshire's 34.7MW of solar power and 27.5MW/30MWh of energy storage project has successfully been put into service.
- This project stands as the largest subsidy-free solar-plus-storage system in the UK.
- This is UK's first government project to achieve 100% clean energy.



### Uniper awarded 10MWh ESS project to Alfen

- System integrator Alfen has been awarded the contract by Uniper to deliver a 10MW / 10MWh energy storage system at Port of Rotterdam.
- The project will be combined with Uniper's hybrid power plant at Maasvlakte where the company operates a 1GW hard coal and biomass plant and a 70MW CHP generation facility.
- The project is expected to be commissioned and in action by the third quarter of 2020.



Bushveld Minerals has planned to back redT for its merger with Avalon Battery. The backing provided in terms of financial loan will be used by redT to fund ongoing working capital requirements and expenses relating to the proposed merger. The loan will also allow the company to finalize due diligence process, conclude negotiations and progress the fundraising round planned for after the transaction.

## Mergers and Acquisitions Taking Place in Energy Storage Market

### EDF entered EV Charging by acquiring Pivot Power to lead future energy storage

- EDF Group has announced the acquisition of Pivot Power which specializes in battery storage and infrastructure for electric vehicle charging following the recent acquisition of PowerFlex Systems.
- These acquisitions depict EDF's plan to stay ahead in Energy storage and Electric Mobility market.



- Through this, EDF is strengthening its expertise in various verticals globally and providing global platforms to the start-ups.

### South African vanadium producer Bushveld Minerals to back redT and Avalon Battery merger

- redT energy Plc has received backing of South African vanadium producer Bushveld Minerals for redT's merger with redox flow battery maker Avalon Battery.
- redT energy Plc will receive an interim loan of up to USD 2.5 million from its US suitor Avalon Battery Corporation, which will be funded by up to USD 5 million provided to Avalon by Bushveld Minerals.



### Mitsubishi Corporation and Chubu Electric Power selected as the preferred buyers in a bid for Eneco

- The consortium featuring Mitsubishi Corporation and Chubu Electric Power Co., Inc. is set to buy out Dutch utility, Eneco, after it has been selected as the preferred buyers through their joint establishment of a special purpose company in the Netherlands called Diamond Chubu Europe B.V.



### 1414 Degrees to acquire SolarReserve Australia II Pty Ltd

- 1414 Degrees is set to acquire SolarReserve Australia II Pty Ltd, which owns the Aurora Solar Energy Project near Port Augusta in South Australia.
- Through this acquisition 1414 Degrees intends to use the Aurora Solar Energy Project site to pilot its Thermal Energy Storage System (TESS)-GRID technology.



#### DEVELOPMENTS

#### Emerging Trends



Energy storage market has seen multiple merger and acquisition activities in Q4 2019. These acquisitions mainly aim at capability enhancement, securing market place and developing technology.

Consortium of Mitsubishi Corporation and Chubu Electric Power Co. have planned to buy Eneco to make it the European center for all energy-related activities.

FutureBridge Insight & What should you investigate ?





Cryogenic Energy Storage Technology and Advanced Compressed Air Energy Storage Technology aim to surpass the limitations of Li-ion batteries by allowing long duration energy storage. Further, these technologies have longer life span, are efficient and cost competitive and can be built on large scale. These emission free technologies can be sited at any location.

## New Technologies are Securing Place in the Market



### Highview Power to Develop Europe's Largest Storage System using cryogenic technology

- Highview Power has planned to develop multiple cryogenic energy storage systems across the UK.
- The company will also build Europe's largest storage system sized 50 MW, 250 MWh using cryogenic technology in North of England.
- As cryogenic storage technology facilitates multiple grid services and allows energy storage for long duration (for weeks), it has the potential to be a key enabler for a 100% carbon free future.



### Highview Power to develop Liquid Air Energy Storage System in the United States

- Long duration energy storage solutions provider Highview Power Storage, Inc. and renewable energy generation and storage projects developer Encore Renewable Energy have announced plans to develop long duration, liquid air energy storage system with minimum size of 50MW to provide eight hours of storage (400MWh) in northern Vermont.
- The project will be first of its kind in the US, while company has planned multiple such projects across the US.



### Hydrostor and NRStor have announced completion of World's first commercial Advanced-CAES Facility

- Hydrostor in partnership with NRStor have announced the completion of the Goderich Advanced Compressed Air Energy Storage (A-CAES) Facility, located in Goderich, Ontario, Canada.
- The plant is a pivotal advancement in long-duration energy storage as it is the world's first successful demonstration of commercialized fuel-free (adiabatic) CAES technology.
- The facility in operation will establish the ability of A-CAES technology to participate in and deliver a wide range of valuable grid services to electricity markets.

#### DEVELOPMENTS

#### Emerging Trends



This quarter has witnessed deployment of commercial projects based on Cryogenic Energy Storage Technology and Advanced Compressed Air Energy Storage Technology for the first time in the world. Cryogenic Energy Storage Technology

by Highview Power and Advanced Compressed Air Energy Storage Technology by Hydrostor are the proprietary technologies by respective companies and were recently developed.

FutureBridge Insight & What should you investigate ?



## → FutureBridge Insight on Grid Scale Energy Storage

With the increased need of electric grid reliability and renewable energy grid integration, energy storage is becoming a crucial grid component. Considering this fact the US and Europe are putting rigorous efforts to install energy storage projects.

Cryogenic energy storage technology and advanced compressed air technology are posed to capture the market while competing with Li-ion batteries.

## What should you investigate ?



What is the future outlook and market for Cryogenic Energy Storage and Advanced Compressed Air Energy Storage Technologies?



What are the market opportunities in the new 'Land Leasing' business model for energy storage projects?

## A New Business Model in Energy Storage Market by Consolidated Edison



Conventional Business Model	
<ul style="list-style-type: none"> <li>➤ Bill management business case - Batteries used to lower the power bill</li> <li>➤ Search for a business willing to invest into battery system for energy bill reduction</li> </ul>	<ul style="list-style-type: none"> <li>➤ Customer sited projects</li> <li>➤ System size is capped according to customer load</li> </ul>
<ul style="list-style-type: none"> <li>➤ Suitable energy demand profiles required for bill reduction by battery usage</li> <li>➤ Uncertainty for utilities if battery system can serve grid at particular location and time</li> </ul>	<ul style="list-style-type: none"> <li>➤ Battery system juggle to manage local grid peak and peak load of the customer to achieve bill reduction and generate revenue</li> <li>➤ Revenue depends upon aggregated grid services</li> </ul>
New Business Model	
<ul style="list-style-type: none"> <li>➤ Allows utility to be in the Driver's Seat</li> <li>➤ Front-of-meter battery energy storage</li> </ul>	<ul style="list-style-type: none"> <li>➤ Battery makes money by delivering capacity to the utility</li> <li>➤ Option of dispatching for wholesale market revenue when the grid doesn't need the assets</li> </ul>
<ul style="list-style-type: none"> <li>➤ Focus on providing grid services</li> <li>➤ Acts as a flexible resource to defer expensive grid upgrades</li> </ul>	<ul style="list-style-type: none"> <li>➤ Direct relationship between developer and utility</li> </ul>
<ul style="list-style-type: none"> <li>➤ Can be located at the location where utility needs peak-load reduction or voltage support</li> <li>➤ No upper cap for system size: can be sized larger to meet the grid's needs</li> </ul>	<ul style="list-style-type: none"> <li>➤ Easily scalable and replicable business model</li> </ul>
<ul style="list-style-type: none"> <li>➤ Host needs to take only land leasing decision to get back easy money</li> <li>➤ No complex discussions on energy management required from developer side</li> </ul>	<ul style="list-style-type: none"> <li>➤ Creation of a new market without threatening the old market</li> </ul>

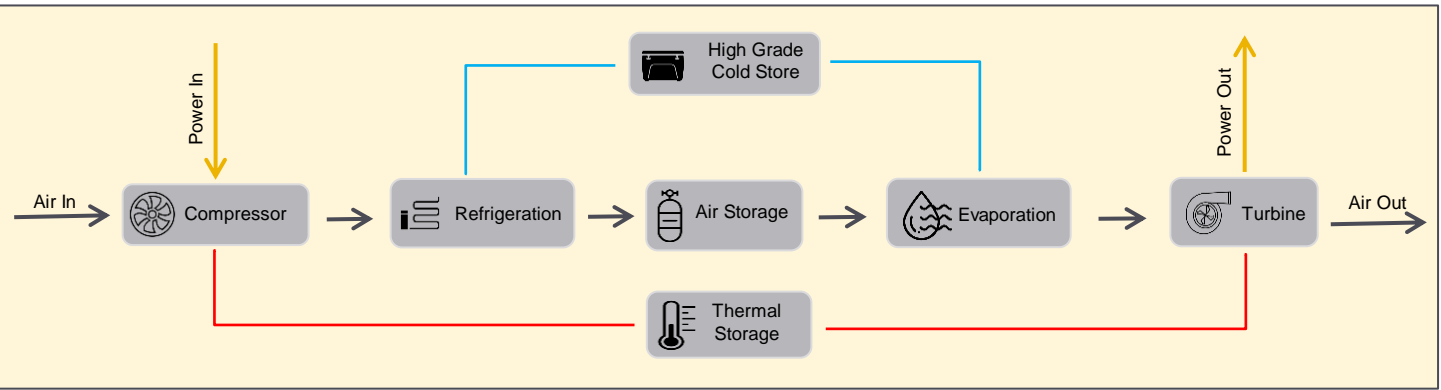


# 02

## New Technologies Deployed in Projects

# Cryogenic Energy Storage

Process



Key Features

- 30+ years lifetime
- Lowest cost
- 60% - 70% Efficiency
- Zero emissions
- Ready to deploy
- Build anywhere
- Large-scale

Applications

	Power Generation	Transmission	Distribution	End Users
	<ul style="list-style-type: none"> <li>Managing intermittent renewable generation</li> <li>Energy arbitrage</li> <li>Peak shaving</li> <li>Improved heat rate</li> <li>Waste heat</li> </ul>	<ul style="list-style-type: none"> <li>Ancillary services</li> <li>Transmission constraints</li> <li>Inertia services</li> <li>Responsive flexibility services</li> <li>Voltage support</li> </ul>	<ul style="list-style-type: none"> <li>Reactive power</li> <li>Voltage support</li> <li>Local security</li> <li>Distribution losses</li> </ul>	<ul style="list-style-type: none"> <li>Power reliability</li> <li>Energy management</li> <li>Waste heat recovery</li> <li>Waste cold usage</li> </ul>

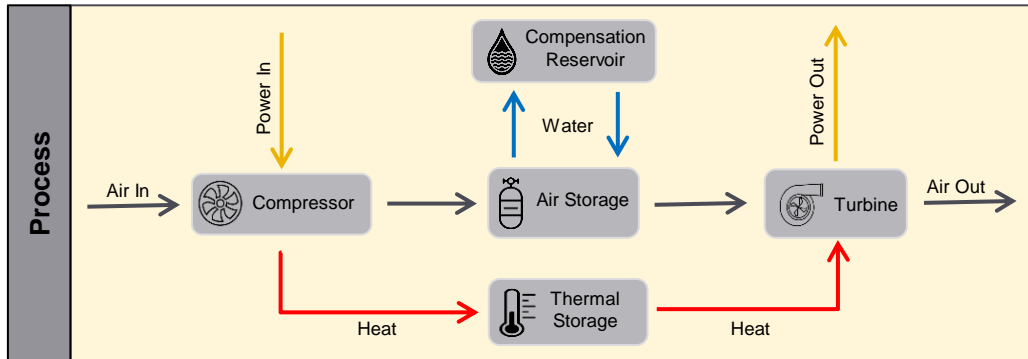
## Technology

The system works on thermodynamic cycle and can interface with collocated thermal processes such as LNG regasification plants, peaking plants and industrial applications to utilize waste heat and cold streams, improving the roundtrip efficiency



Cryogenic energy storage technology is a proprietary technology by Highview Power. The company introduced the technology in June 2019. Highview Power has planned multiple grid-scale energy storage projects based on cryogenic technology across Europe and US.

# Advanced Compressed Air Energy Storage



### Benefits

- Low Cost
- Flexible Siting
- Emission Free
- Ancillary Services
- Customized System Design
- Proven Solution

### Applications

- Fossil Plant Replacement
- Renewable Integration
- Transmission Deferral
- Mines & Large Industrial

### Hydrostor A-CAES Projects

**Toronto Facility**

In-Service: 2015  
Application: Technical demonstration, R&D

**Angas Project**

In-Service: 2020  
Application: Load leveling, frequency response, inertia

**Goderich Facility**

In-Service: 2019  
Application: Commercial demonstration, peaking capacity

Peak power output: 1.75 MW  
Charge rating: 2.2 MW  
storage capacity: 10+ MWh

First-of-its-kind utility-scale commercial application of A-CAES technology.

Energy Storage North America Innovation Award in November 2019.

Advanced Compressed Air Energy Storage Technology works with the same process flow as conventional Compressed Air Energy Storage Technology. But following two are the innovations in Advanced Compressed Air Energy Storage Technology to enable emission-free operation and siting flexibility.

- A proprietary thermal management system
- The use of purpose-built hard-rock air-storage caverns

## 03

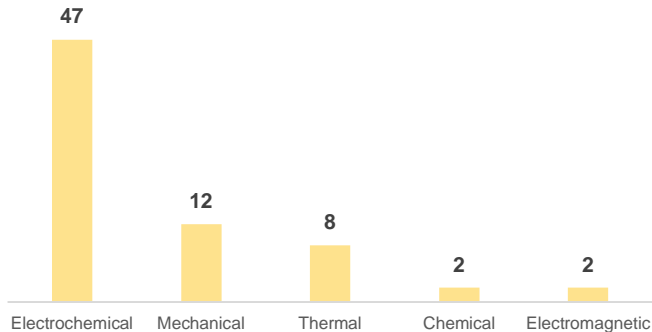
## Startup Tracker highlights

## Startup Tracker summary Q4 2019

71

Total  
Startups

## Distribution by technology segmentation



Note: Technology of one start-up is not disclosed while another start-up works on two technologies

## Recent Activities

## Funding



Founded in 2010, Harmony Energy is one of the UK's leading independent developers of utility-scale battery energy storage projects. The company also develops, builds, owns and operates wind and solar projects.

Yorkshire, UK



Harmony Energy is being backed by Fotowatio Renewable Ventures (FRV) at Holes Bay to develop energy storage project. This is the first ever investment in battery project by FRV as part of a long-term investment plan to develop energy storage projects globally.

## Acquisition

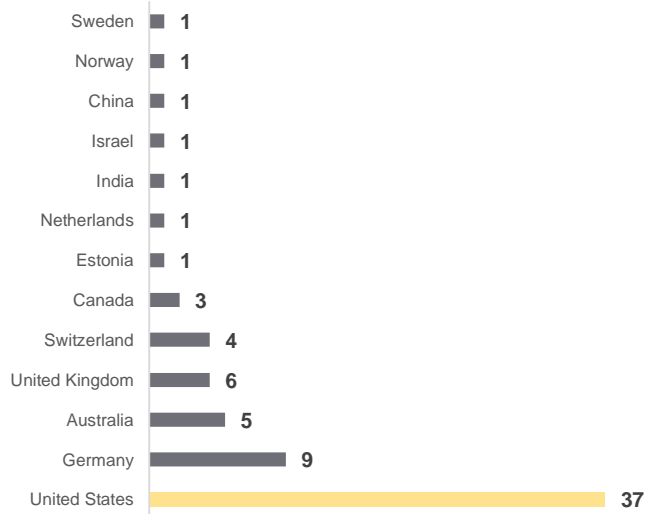
Founded in 2011, Convergent is the leading independent developer of energy storage solutions in North America.

New York, US

Energy Capital Partners (ECP) has acquired Convergent Energy + Power (Convergent) to fund Convergent's future pipeline of projects. Convergent has raised and deployed over \$70M of equity and debt financing into over 120 MW / 240 MWh of energy storage projects since its foundation.

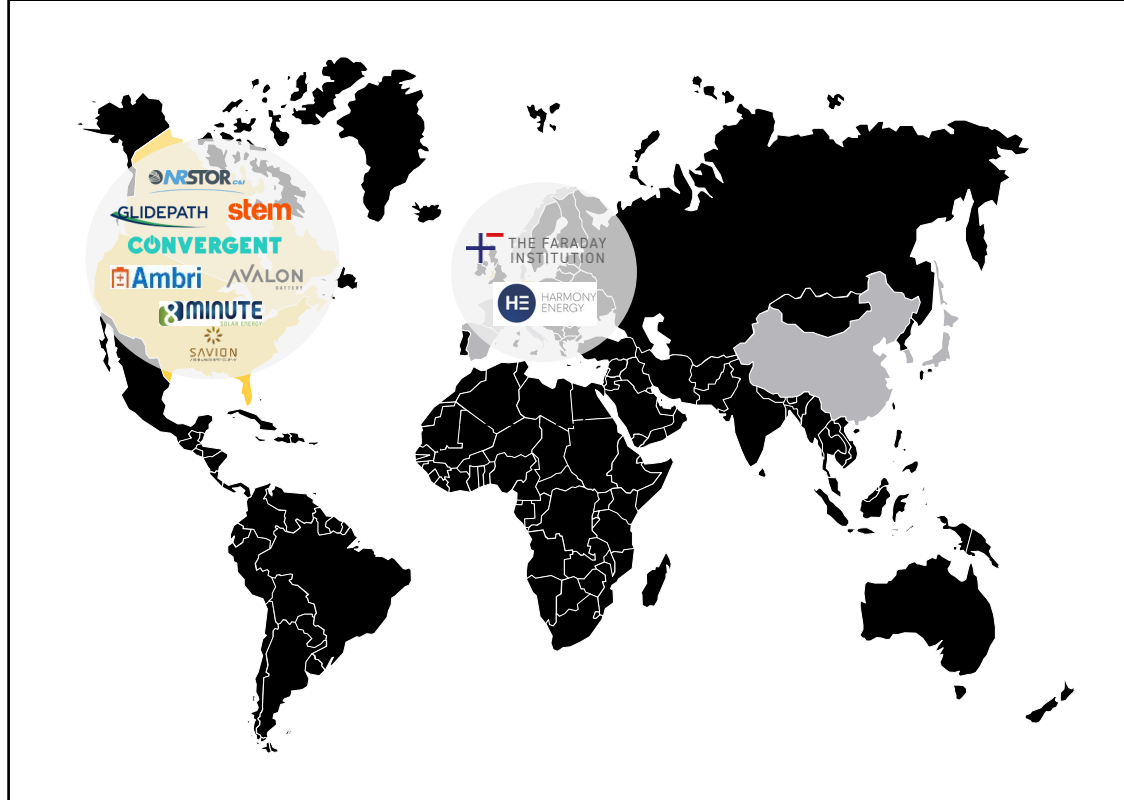
## What are the hubs of startup innovation for Grid Scale Energy Storage Technology

Distribution of Start-ups by Country



- United States is the hot bed for startups with around 50% of the startups originating from the country
- Electrochemical technology is the preferred choice among startups with over 66% of them have their product based on the technology

Key startups from major hubs



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